Republic of Kenya

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KENYA STANDARD

The warehousing of dangerous goods

Part 1: General requirements

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In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

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KENYA STANDARD

The warehousing of dangerous goods

Part 1: General requirements

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Foreword

This Kenya Standard was developed by the Technical Committee on Transportation of dangerous goods under the supervision of the standards project committee, and is in accordance with the procedures of the Bureau
Acknowledgement is hereby made for the assistance derived from these sources
.SANS 10263-0:2010
The warehousing of dangerous goods

Part 1: General requirements

The warehousing of dangerous goods Part 1: General requirements

1 Scope

This document lays down design features and procedures to be followed to minimize risks to the safety of persons, property and the environment in cases where emergencies occur in warehouses used for the storage of dangerous goods. It applies to the warehousing of dangerous goods in excess of certain quantities.

This document applies to the uncovered and covered storage of dangerous goods in warehouses that form part of a manufacturing operation, in distributors' warehouses, and in the storage areas of wholesale and retail premises.

Some of the provisions of this standard might not apply in certain cases, for example small-scale business enterprises. Notwithstanding the provisions of annex A, this standard does not apply to areas where limited materials are displayed and advertised on shelves for sale to the public (as in the retail sections of supermarkets, hardware shops, home garden outlets, etc.), or to storage areas in laboratories.

The requirements of this standard do not apply to the storage of pesticides).

NOTE 1 Annex A lists, by SANS 10228 classification, the quantities of dangerous goods to which the provisions of this standard apply.

NOTE 2 The provisions of this standard are likely to vary in their applicability to the warehousing of different types or classes of dangerous goods. Ultimately, the elements of safe warehousing practice are determined by the nature of the goods stored. In some cases, actions, precautions and provisions that are additional to or different from those outlined in this standard could be required. Although it is believed that the adoption of this standard will help to reduce the risk of accident, the SABS Standards Division cannot accept any responsibility for any kind of damage or alleged damage in or about the premises, areas or vehicles to which this standard has been applied.

NOTE 3 Where the provisions of this standard conflict with, or appear to diverge from, the regulations (as defined in 3.12), the regulations take precedence. This standard is intended to supplement the regulations by giving greater detail in certain areas than can be provided for in the regulations, which, because of necessity, are drafted in broad terms.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the Referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

ANSI/NFPA 11, *Standard for low-, medium- and high-expansion foam systems*.

SANS 509/ISO 509, *Pallet trucks – Principal dimensions*.

SANS 543, *Fire hose reels (with semi-rigid hose)*.

SANS 1128-1, *Firefighting equipment – Part 1: Components of underground and above-ground hydrant systems*.

SANS 1128-2, *Firefighting equipment – Part 2: Hose couplings, connectors, and branch pipe and nozzle connections*.

SANS 1186-1, *Symbolic safety signs − Part 1: Standard signs and general requirements.*

SANS 1253, *Fire-doors and fire-shutters*.

SANS 1456-1, *Collapsible delivery hose for fire-fighting purposes − Part 1: General requirements and methods of test.*

SANS 1522, *Fire extinguishing powders*.

SANS 1567, *Portable rechargeable fire extinguishers – CO_2 type extinguishers.*

SANS 1726-1/EN 1726-1, *Safety of industrial trucks – Self-propelled trucks up to and including 10 000 kg capacity and industrial tractors with a drawbar pull up to and including 20 000 N – Part 1: General requirements.*

SANS 1726-2/EN 1726-2, *Safety of industrial trucks – Self-propelled trucks up to and including 10 000 kg capacity and tractors with a drawbar pull up to and including 20 000 N – Part 2: Additional requirements for trucks with elevating operator position and trucks specifically designed to travel with elevated loads.*

SANS 1910, *Portable refillable fire extinguishers.*

SANS 10086-3 (SABS 086-3), *The installation, inspection and maintenance of equipment used in explosive atmospheres − Part 3: Repair and overhaul of apparatus used in explosive atmospheres.*
SANS 10100-1 (SABS 0100-1), *The structural use of concrete – Part 1: Design*.
SANS 10100-2 (SABS 0100-2), *The structural use of concrete – Part 2: Materials and execution of work*.
SANS 10104 (SABS 0104), *Handrailing and balustrading (safety aspects)*.
SANS 10105-1, *The use and control of fire-fighting equipment – Part 1: Portable and wheeled (mobile) fire extinguishers*.
SANS 10105-2, *The use and control of fire-fighting equipment – Part 2: Fire hose reels*, *hydrants and booster connections* .
SANS 10108, *The classification of hazardous locations and the selection of apparatus for use in such locations*.
SANS 10114-1, *Interior lighting – Part 1: Artificial lighting of interiors*.
SANS 10119 (SABS 0119), *Reduction of explosion hazards presented by electrical equipment − Segregation, ventilation and pressurization.*
SANS 10123 (SABS 0123), *The control of undesirable static electricity*.
SANS 10137 (SABS 0137), *The installation of glazing in buildings*.
SANS 10139, *Fire detection and alarm systems for buildings − System design, installation and servicing.*
SANS 10142-1, *The wiring of premises − Part 1: Low voltage installations*.
SANS 10143 (SABS 0143), *Building drawing practice*.
SANS 10160 (SABS 0160), *The general procedures and loadings to be adopted in the design of buildings*.
SANS 10161 (SABS 0161), *The design of foundations for buildings*.
SANS 10162-1, *The structural use of steel – Part 1: Limit-states design of hot-rolled steelwork*.
SANS 10162-2 (SABS 0162-2), *The structural use of steel – Part 2: Limit-states design of coldformed steelwork*.
SANS 10163-1, *The structural use of timber – Part 1: Limit-states design*.
SANS 10163-2 (SABS 0163-2), *The structural use of timber – Part 2: Allowable stress design*.
SANS 10164-1 (SABS 0164-1), *The structural use of masonry – Part 1: Unreinforced masonry walling*.
SANS 10164-2, *The structural use of masonry – Part 2: Structural design and requirements for reinforced and prestressed masonry*.
SANS 10206, *The handling, storage and disposal of pesticides.*
SANS 10220, *The selection, use and maintenance of respiratory protective equipment.*
SANS 10228:2006, *The identification and classification of dangerous goods for transport.*
SANS 10229-1, *Transport of dangerous goods − Packaging and large packaging for road and rail transport − Part 1: Packaging.*
SANS 10229-2, *Transport of dangerous goods – Packaging and large packaging for road and rail transport – Part 2: Large packaging.*
SANS 10231, *Transport of dangerous goods – Operational requirements for road vehicles*.
SANS 10232-1, *Transport of dangerous goods – Emergency information systems – Part 1: Emergency information system for road transportation*.
SANS 10233, *Transport of dangerous goods − Intermediate bulk containers for road and rail transport*.
SANS 10234, *Globally Harmonized System of classification and labelling of chemicals (GHS).*
SANS 10263-2*, The warehousing of dangerous goods – Part 2: The storage and handling of gas cylinders*
SANS 10263-5, *The warehousing of dangerous goods – Part 5: The storage and handling of oxidizing substances.*
SANS 10313, *Protection against lightning – Physical damage to structures and life hazard.*
SANS 10400 (SABS 0400:1990), *The application of the National Building Regulations*.
SANS 10406, *Transport of dangerous goods – The reprocessing of previously certified packaging.*
SANS 11014/ISO 11014, *Safety data sheet for chemical products – Content and order of sections.*

3 Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

approved

approved by the authority administering this standard

3.2

competent person

person who is qualified by virtue of his experience and training

3.3

dangerous (hazardous) goods

dangerous substances or goods, as identified and classified in SANS 10228, that are stored before being offered for transport by a manufacturer, distributor, wholesaler or retailer, or that are stored by an end user

NOTE For the purposes of this standard, the terms

a) "dangerous" and "hazardous" are synonymous, and

b) "goods" and "product" are used interchangeably and, except where it is clear from the context that the normal dictionary meaning of a term is intended, they refer to dangerous goods, as defined in 3.3.

3.4

documented

provided in writing

3.5

empty packaging

previously certified packaging from which contents have been removed as far as possible, by means of the practices commonly employed to remove materials from that type of container, for example pouring, pumping, or aspirating

11

3.6

enclosed warehouse

surface warehouse (see 7.4), a multi-storey warehouse (see 7.5), a high-rack warehouse (see 7.6) or a special warehouse (see 7.7)

3.7

fire section

warehouse section in which products of one or more SANS 10228 classes are to be stored, that has been designed for the storage of specific products, and that is intended to confine or retard the progress of a fire

NOTE Maximum permissible storage quantities and minimum permissible fire-fighting water supplies are laid down for each fire section (see annex B).

3.8

non-combustible

classified as non-combustible when tested in accordance with SANS 10177-5

3.9

occupancy class

occupancy or building classification, as defined in table 1 of part A of the National Building Regulations

3.10

package

complete product of the packing operation, consisting of the packaging and its contents

3.11

packaging

receptacles and any other components or material necessary for a receptacle to perform its containment function

3.12

regulations

any relevant current national, provincial or local authority legislation or by-laws, or regulations promulgated in terms of any Act of Parliament

3.13

safety data sheet

document, issued by a manufacturer of dangerous goods, that lists information about the handling, storage, transport and emergency procedures relevant to the dangerous goods supplied by the manufacturer

3.14

segregation

positioning of products of different classes or divisions in terms of SANS 10228 in separate areas within a warehouse

NOTE The concepts “segregation” and “separation” are subject to widespread misinterpretation in industry; considerable differences in usage exist, and there is no universally accepted set of definitions for these terms. The onus is nevertheless on the warehouse controller to ensure at all times that products are stored in a safe and responsible manner (see table B.1).

3.15

separating element

wall or floor that has a specific fire resistance and that is used between divisions, occupancies or tenancies in a building

NOTE See SANS 10400 for further information.

3.16

separation

physical separation of different product groups, either in separate warehouses or by means of separating elements, such as a wall, that has a specific fire resistance and that is used between divisions within a warehouse

NOTE 1 See the note to 3.14.

NOTE 2 See SANS 10400 for further information on fire-resistant separating elements.

3.17

United Nations (UN) number

serial number that consists of four digits and that is assigned to dangerous goods by the United Nations’ Committee of Experts on the Transport of Dangerous Goods

3.18

warehouse controller

responsible person(s) on site, including, where applicable, the responsible person(s) appointed in terms of the regulations (see 3.12), and the competent person(s) appointed to take charge of specific operations in a warehouse.

3.19

warehouses

3.19.1

dangerous-goods warehouse

any area, building or structure designed, intended or used for, or to facilitate, the storage of dangerous goods in excess of the applicable quantities detailed in annex A

3.19.2

stock warehouse

building(s) or part(s) of a building in which dangerous goods are actually stored

3.20

warehouse section

subdivision of a warehouse, the dimensions, features and location of which have been determined by a process of reasoning or calculation (or both) that have regard to the nature of the products to be stored in it

3.21

warehousing

receipt, marshalling, storage and despatch of dangerous goods

4 Application of the standard and classification

4.1 Application of the standard

There is no objection to the use of other national or international standards, or systems, methods, or devices that comply with or exceed the requirements of this standard, provided technical documentation is submitted to the authority that has jurisdiction that demonstrates compliance with this standard through rational design and provided that the system, method, or device is approved for the intended purpose.

4.2 Classification

4.2.1 General

For the purposes of this standard, dangerous substances are classified into classes and divisions depending on the hazards they pose and into categories depending on the severity of the hazard. Testing shall be performed in accordance with SANS 10228.

NOTE All aspects of the identification and classification of dangerous goods for transport are dealt with in detail in SANS 10228.

4.2.2 Class 1: explosives

4.2.2.1 Substances, mixtures and articles of this class that are not classified as an unstable explosive are assigned to one of six divisions depending on the type of hazard they represent:

a) **Division 1.1** – substances, mixtures and articles that present a mass explosion hazard;

NOTE A mass explosion is one that affects the entire quantity present, virtually instantaneously.

b) **Division 1.2** – substances, mixtures and articles that present a projection hazard but not a mass explosion hazard;

c) **Division 1.3** – substances, mixtures and articles that present a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard:

1) Combustion of which gives rise to considerable radiant heat; or

2) which burn one after another, producing minor blast or projection effects (or both);

d) **Division 1.4** – substances, mixtures and articles that present:

1) No significant hazard; and

2) Only a small hazard in the event of ignition or initiation. The effects are largely confined to the Package and no projection of fragments of appreciable size or range is to be expected. An External fire shall not cause virtually instantaneous explosion of almost the entire contents of the package;

e) **division 1.5** – very insensitive substances or mixtures that present a mass explosion hazard, but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions; and

f) **division 1.6** – extremely insensitive articles that do not present a mass explosion hazard and the probability of accidental initiation or propagation is negligible.

NOTE The risk of explosion is limited to a single article.

4.2.2.2 Explosives, other than unstable explosives, are classified in one of the six divisions in accordance with Test Series 2 to Test Series 8 in Part I of the United Nations' *Recommendations on the transport of dangerous goods: Manual of tests and criteria* (see also SANS 10228).

4.2.3 Class 2: gases

This class is subdivided as follows:

a) **division 2.1**: flammable gases;

b) **division 2.2**: non-flammable, non-toxic gases; and

c) division 2.3: toxic gases.

4.2.4 Class 3: flammable liquids

A flammable liquid is classified in one of the four categories as indicated in table 1.

Table 1 — Categories and classification criteria for flammable liquids

4.2.5 Class 4: flammable solids; substances liable to spontaneous combustion; substances that, on contact with water, emit flammable gases – Types of self-reactive substances or mixtures

This class is subdivided as follows:

a) **Division 4.1**: flammable solids, self-reactive substances and solid desensitized explosives;

b) **Division 4.2**: substances liable to spontaneous combustion (pyrophoric and self-heating substances category 1 and 2); and

c) **Division 4.3**: substances that, on contact with water, emit flammable gases.

4.2.6 Class 5: oxidizing substances and organic peroxides

This class is subdivided as follows:

a) **Division 5.1**: oxidizing substances; and
b) **Division 5.2**: organic peroxides.

4.2.7 Class 6: toxic and infectious substances

This class is subdivided as follows:

a) **Division 6.1**: toxic substances; and
b) **Division 6.2**: infectious substances.

4.2.8 Class 7: radioactive material

This class has no subclasses.

4.2.9 Class 8: corrosives

This class has no subclasses and comprises substances that, by chemical action, cause damage to living tissue, to commonly used metals, or to packaging.

4.2.10 Class 9: miscellaneous dangerous substances

This class has no subclasses and comprises any substance not covered by other classes, but that has been, or could be shown by experience, to be of such a dangerous character that the provisions of this class should apply to it.

4.3 Dangerous goods listings for packaging

4.3.1 General

Kenya has adopted the globally used UN classification, numbering and packaging systems for dangerous goods. These are published in SANS 10228 for classification,

4.3.2 Annex B of SANS 10228:2006

4.3.2.1 B.1 of SANS 10228:2006 gives the relevant special provisions relating to individual articles or substances.

4.3.2.2 B.2 of SANS 10228:2006 consists of a numerical list of dangerous goods and gives, in tabulated form, the information required for identification and classification, i.e. the UN number, the technical name and description, the class, the packing group, the subsidiary risk, references to appropriate packing instructions, and special provisions and limited quantity requirements.

4.3.3 Annex C of SANS 10228:2006

This annex consists of an alphabetical list of dangerous goods and gives, in tabulated form, the proper shipping name, the UN number and the class or division.

5 Preliminary storage considerations

5.1 General

5.1.1 In general, before a warehouse may store dangerous substances of any class (see 4.2) or of any hazard category, all the relevant provisions of this standard, and all relevant regulations (as defined in 3.12) shall be complied with. The storage of certain dangerous goods is subject to product-specific regulations.

5.1.2 If certain classes of dangerous substances, for example explosives and radioactive material, are not going to be stored, the legislation and regulations relevant to those classes are unlikely to be applicable (see foreword).

5.1.3 If a warehouse is to restrict itself to the storage of flammable substances of category 3 only, or of category 2 and category 3, certain provisions of this standard may be relaxed by the authority administering this standard.

5.1.4 If a warehouse does not comply with all the relevant provisions of this standard necessary for it to be permitted to store flammable substances of category 3, it is unlikely that it will be permitted to store flammable substances of category 2.

5.1.5 Similarly, if a warehouse does not comply with all the relevant provisions of this standard necessary for it to be permitted to store flammable substances of category 2, it is unlikely that it will be permitted to store flammable substances of category 1.

5.1.6 The specific provisions of this standard that have to be complied with in any particular case will be determined by the authority administering this standard. For example, certain provisions of this standard may be relaxed, or might not apply, where small-scale warehousing operations are concerned.

5.1.7 The class(es) and hazardous categories of substances to be stored, and the size of the proposed warehousing operation, will determine the necessary degree of compliance with this standard, the regulations that have to be complied with, and, ultimately, the scale and cost of the warehousing operation.

5.2 Site logistics

A company or an organization that requires the use of more than one warehouse shall, as far as is practicable, minimize the overall hazard by selecting an appropriate compromise between:

a) the minimum number of warehouse sites necessary to satisfy customer requirements; and

b) the hazards incurred in road and rail transport of dangerous goods between sites.

5.3 Site location

A company or an organization, when proposing a location for a warehouse and when applying for authority to set up or extend a warehouse, and the local, provincial or national authorities responsible for considering such an application, shall undertake an environmental impact assessment, and in so doing, shall take the following into account:

a) the nature of the goods that will be stored, proposed stock levels (taking into account seasonal variations) and the degree of hazard that will be presented;

b) the zoning or land-use requirements of the local authority;

c) proximity to houses, schools, hospitals, offices, factories and similar high-occupancy areas and to potential external sources of hazard, and the level of the ground in relation to such areas;

d) fire protection, security, and general service facilities in the area;

e) population densities around the proposed warehouse;

f) proximity to water courses (surface and underground) and to open storm water r channels;

g) proximity to combustible vegetation;

h) prevailing winds and other climatic factors;

i) the stability of the ground on which buildings and roadways will be constructed;

j) the highest recorded flood level in the proposed storage area, and the susceptibility of the area to flooding;

k) access to the site by road and rail;

l) access to the site, and in particular to buildings, by emergency service vehicles, and the desirability of allowing the parking of vehicles in areas adjoining the buildings;

m) safe escape from the effects of fire or other hazards in each of the proposed buildings on site;

n) the adequacy of the services to be provided, including

1) electricity supply and emergency supply, if needed,

2) potable and firefighting water supply, and

3) drainage that

- **either** prevents ground run-off to public sewers and storm drains,
- **or** allows run-off to a waste treatment plant intended to be used for on-site containment of run-off water and spills,
- **or** does both;

o) future expansion;

p) the depth of the water table (if above the first impermeable layer) and the date of measurement;

q) the soil types above the first impermeable layer; and

r) the location of any existing boreholes or artesian wells within 500 m of the site, and an analysis of their water for pollutants (especially hydrocarbons) likely to be generated in the event of a major fire or spillage in the proposed premises.

NOTE To facilitate future monitoring of the environment, (p) (q) and (r) above, in particular, should be recorded before construction commences.

CAUTION — Consideration should be given to the locations of existing warehouses and a Risk Assessment carried out in terms of this standard.

5.4 Location and spacing of buildings

5.4.1 Separate administrative buildings

Administrative buildings shall, if the scale of operations permits, be separate from buildings in which dangerous goods are stored. Separate administrative buildings shall be located in a safe area (preferably near the main gates), with direct access from the roadway so that visitors to the offices only are not required to enter the operational area of the warehouse. As far as is practicable, no offices, eating areas or change rooms shall be built as an integral part of a stock warehouse.

5.4.2 Stock warehouses

If the outer boundary of the site is constructed of open-type fencing, a stock warehouse that contains flammable materials shall be sited at least 22 m away from the boundary. The authority administering this standard might allow this distance to be reduced if the boundary consists of a solid wall, or if the quantities and types of flammable material stored are such that this distance is deemed unnecessary.

5.4.3 Service buildings

Service buildings do not constitute an inherent fire hazard, but could include open fires or other fire hazards. They shall be sited in areas away from places where dangerous goods are stored and handled, and out of the line of possible vapour travel.

5.4.4 Boiler houses, power plants, fire pump slabs and similar installations

Boiler houses, power plants, fire pump slabs and similar installations, shall be so located that their equipment can be operated safely in the event of a fire occurring elsewhere on the site.

5.4.5 Buildings on boundaries

The walls of any buildings, other than buildings in which dangerous goods are stored, may, subject to the regulations, form part of the boundary of the site.

5.5 Approval by authorities

5.5.1 No warehousing operation shall be started in any premises unless application has been made to the authority(ies), the necessary permission has been obtained from all relevant department(s) (fire, public health, sewerage, building inspectorate, etc.), and a certificate of occupancy has been issued by the authority in terms of the National Building Regulations (see foreword). All permits shall be renewed as necessary and as required by the authorities. The carrying out or continuation of a warehousing operation without the prescribed permits is not permitted.

5.5.2 When a proposed change of occupancy brings premises within the scope of this standard, the relevant provisions of 5.5.1 shall be complied with before warehousing operations may start. In particular, an existing building or part of a building in which a change of occupancy to warehousing as defined in 3.21 is proposed, shall be required to comply fully with National Building Regulations (see foreword).

5.5.3 Early consultation with the relevant authorities is recommended, as is the provision of an adequate brief covering the intended use of the premises and the goods intended to be stored or used. In this way, the necessary permits, such as flammable liquids permits, can be applied for in good time and the need to provide costly additional measures, such as fire safety measures, after the premises are otherwise ready for occupation, could be avoided.

5.6 Warehouse sections and fire sections

5.6.1 The minimum number of warehouse sections needed shall be estimated from a knowledge of the dangerous goods to be stored (see SANS 10228), their separation and segregation requirements (see 12.8), and any product-specific requirements, such as climatic control.

5.6.2 The minimum number of fire sections needed shall be estimated from a knowledge of the dangerous goods and the quantities to be stored (see table B.1).

5.6.3 Estimates shall then be made of the optimum numbers, sizes and constructional requirements of individual warehouse sections and fire sections, taking into account variables such as

a) firefighting water requirements (see annex B),
b) spillage containment requirements (see 8.4),
c) technical safety requirements, for example, explosion prevention measures, and
d) anticipated fire detection and firefighting capability.

5.6.4 These estimates shall be taken into account in the drawing up of building and site plans. In particular, the possible benefits of separating all flammable materials from other goods shall be considered. The feasibility of such an arrangement will depend on the relative quantities to be stored.

5.7 Building, site and fire protection plans

5.7.1 The building and site plans shall comply with national building regulations

5.7.2 A fire protection plan as described in A.9 shall be completed in respect of

a) all new warehouse buildings,
b) extensions to existing warehouse buildings, and
c) any building in which a change of use is proposed which would bring the use of the building within the scope of this standard.

5.7.3 The storage areas in a stock warehouse are classified in classes of occupancy as follows:

a) **High-risk storage (J1):** Occupancy where the stored goods are liable, in the event of fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions.

b) **Moderate-risk storage (J2):** Occupancy where the stored goods are liable, in the event of fire, to cause combustion with moderate rapidity but not likely to give rise to poisonous fumes, or cause explosions.

c) **Low-risk storage (J3):** Occupancy where the goods stored do not fall into the high or moderate risk category.

NOTE Any space used for the storage of flammable liquids is not deemed to be a J1 occupancy if the quantity of liquid

a) does not exceed 40 L, or

b) exceeds 40 L but does not exceed 200 L and the closed-cup flash point of such a liquid is above 40 °C.

5.8 Emergency plans and external safety inspection

Before warehousing operations start, the necessary emergency plans shall have been completed and distributed (see clause 16), the initial external safety inspection (see 19.2.1) shall have been carried out and a certificate of compliance with the provisions of this standard shall have been obtained.

5.9 Pollution control

The design and operation of the warehouse shall be such that the storage of dangerous goods will not cause contravention of the relevant national regulations and statutory provisions, in that all reasonable steps shall be taken to prevent pollution (see foreword).

NOTE See part P of the National Building Regulations.

5.10 Facilities to be provided

The combination of facilities to be provided in a warehouse, including the design of buildings, all safety-related and fire-related facilities and the type(s) of warehouse technology and operating equipment required, shall be determined by a logical process that takes into account all relevant circumstances, risks and uses to which the warehouse will be subjected.

6 Key responsibilities

6.1 National, provincial and local authorities

6.1.1 Before issuing permits to start or continue warehousing operations, authorities shall ensure that the relevant provisions of clause 5 and the regulations have been met (see 6.4 for the specific responsibilities of the fire authorities).

6.1.2 Authorities shall not permit incompatible buildings or facilities (such as schools and shops) to be built too close to a proposed or existing warehouse site.

6.2 The owner of the goods to be stored

6.2.1 The owner of the goods to be stored in a warehouse shall, as far as is practicable, satisfy himself that the warehouse controller will ensure compliance with the provisions of this standard, and, in particular, that

a) the warehouse is suitable for its intended purpose,

b) the warehouse controller is trained and competent to carry out the required storage,

c) the warehouse controller clearly understands what is expected,

d) information is supplied to the warehouse controller to ensure and enable safe storage, for example:

1) details of the hazards of the goods;

2) Safety Data Sheets (see 12.5);

3) recommendations for safe handling;

4) instructions to be followed in the event of a spill or leak;

5) first-aid instructions; and

6) a 24-h emergency telephone number through which specialist advice can be obtained,

e) the warehouse controller formally acknowledges in writing receipt of such information and confirms that it has been understood, and

f) the safety, fire protection and emergency arrangements instituted by the warehouse controller are adequate.

6.2.2 The various responsibilities shall be documented, preferably in contract form, and shall allow for regular inspections of the warehouse by the owner of the goods. Where the owner of the goods is also the owner of the warehouse, such a contract is clearly inappropriate; the owner shall nevertheless comply with the other provisions of this subclause as if a third-party relationship existed.

6.3 The warehouse controller

6.3.1 The responsibilities of the warehouse controller shall be stipulated in writing.

6.3.2 The warehouse controller shall be responsible for the occupational health and safety of the people in the warehouse, the safe receipt, marshalling, storage and despatch of goods and the protection of the environment from the hazardous effects of goods stored in the warehouse. Specific responsibilities may be delegated to nominated personnel (see also 6.3.5).

6.3.3 The warehouse controller shall be aware of, and shall comply with, all relevant regulations concerning the employment of personnel.

6.3.4 The warehouse controller shall be aware of, and shall comply with, all relevant regulations concerning the handling and storage of goods to be stored.

6.3.5 The warehouse controller shall entrust the execution of the relevant provisions of this standard to appropriately qualified and experienced people, and shall provide ongoing training as necessary, to ensure the maintenance of standards (see 14.6).

6.3.6 The warehouse controller shall be responsible for communications with the relevant authorities to ensure continuing validity of permits as well as reporting and investigating of any incidents or accidents that occur which may impact on the environment.

6.4 Fire authorities

6.4.1 Fire authorities shall be aware of all warehouses that operate within their area of control, and shall ensure that ongoing liaison is maintained with warehouse controllers and, as necessary, with other emergency services.

6.4.2 Fire authorities shall co-operate with warehouse controllers to ensure that emergency plans (see clause 16) are produced and regularly reviewed, and that any routine checks, assistance with training, or similar activities for which fire authorities have assumed responsibility, are carried out.

6.4.3 Each fire authority shall maintain in an orderly manner, all information, emergency plans and contact telephone numbers with respect to warehouses that operate within its area of control.

6.4.4 Fire authorities shall have access to the necessary personnel and equipment, and shall install the necessary systems, including training programmes, to ensure a rapid, effective response to a fire or other emergency in a warehouse that operates within their area of control.

6.5 Authority administering this standard

The authority administering this standard shall assess the degree to which a warehouse complies with the relevant provisions of this standard and shall consider the granting of exemptions where appropriate. The authority shall, depending on the assessed degree of compliance, authorize the warehouse controller to conduct operations in relation to the storage of dangerous goods of specific classes, and of specific packing groups. Re-assessments shall be carried out on a regular basis to ensure continued compliance, and appropriate certificates of compliance with the provisions of this standard shall be issued or renewed as necessary.

7 Types of warehouses

7.1 General

7.1.1 The following shall be considered when the type of warehouse needed is being selected:

a) the technical safety aspect;
b) the logistical suitability of the design; and
c) capital investment and operating costs.

7.1.2 A warehouse shall be of one of the following types, which are covered in greater detail in 7.2 to 7.7 (inclusive):

a) uncovered outdoor storage yard;
b) covered outdoor storage yard;
c) surface warehouse;
d) multi-storey warehouse;
e) high-rack warehouse; and
f) special warehouse.

7.1.3 The warehouse storage technologies used shall be appropriate for the storage situation(s) encountered. Technologies available for use in warehouses are described in detail in 11.2.

7.2 Uncovered outdoor storage yard

7.2.1 General

An uncovered outdoor storage yard consists of an outdoor area that is surfaced with impervious material. An uncovered outdoor storage yard shall only be operated within the confines of a secured site or plant area, with proper provision for containment (see 7.2.3).

7.2.2 Products that may be stored

An uncovered outdoor storage yard is generally suitable for all goods that are insensitive to temperature and that have weatherproof packaging and marking.

CAUTION — Storage of explosives, radioactive material, water-reactive substances, and infectious substances (classes 1 and 7, and divisions 4.3 and 6.2, respectively) in uncovered outdoor storage yards is expressly prohibited.

7.2.3 Drainage and discharge

The storage area shall not be connected to a sewer direct; it shall be constructed in the form of a retaining basin (and, if appropriate, in combination with a separate catch basin) equipped with a drain valve, from which no water, even rainwater, should be pumped unless analysis of the proposed discharge has shown it to be safe and within permitted limits. The drain valve shall be kept closed during normal operations. The storage area shall be surrounded by, but not connected to, appropriate storm drains to prevent the ingress of large quantities of water during severe rainstorms (see also 8.4.4).

7.2.4 Advantages and disadvantages

7.2.4.1 Advantages

An uncovered outdoor storage yard offers advantages over enclosed constructions for the storage of gases and flammable liquids (classes 2 and 3 respectively), because the natural ventilation prevents a hazardous, explosive atmosphere from arising in all but the most extreme of cases.

7.2.4.2 Disadvantages

The following potential disadvantages exist:

a) heating of goods by solar radiation, coupled with possible damage to, or decomposition of, goods;

b) damage to goods owing to frost;

c) damage (for example, corrosion damage) to packaging owing to precipitation;

d) damage to marking owing to weathering (ultraviolet radiation, rain, etc.);

e) damage to the surface appearance of the packaging after lengthy outside storage, reducing the saleability of goods and causing additional disposal needs;

NOTE Useful measures against these weathering effects include the use of sprinkling systems, tarpaulins to cover goods and the implementation of intensive checking.

f) lower security against theft than in locked buildings.

7.2.5 Firefighting implications

7.2.5.1 An uncovered outdoor storage yard offers the best firefighting conditions for flammable products (no smouldering, immediate detection of the source of a fire and good accessibility).

7.2.5.2 In large, uncovered outdoor storage yards, the required fire sections shall be formed by allowing gaps of width at least 10 m, or by the interposition of separating elements that are at least 1 m higher than the highest storage stack.

7.2.6 Warehouse technology

7.2.6.1 An uncovered outdoor storage yard is suitable for small ranges of high-turnover goods in large quantities. It is preferable that only complete storage units (such as pallets and containers) be stored.

7.2.6.2 Block storage is the most appropriate warehouse technology for uncovered outdoor storage yards (see 11.2.2 to 11.2.4). The allowable useful height is likely to be about 4 m when pallets are stored, and up to 6 m when small containers are stored.

7.2.7 Costs

If the price of the land is low, the capital costs per storage unit for an uncovered outdoor storage yard are the lowest of all types of warehouse. The operating costs are also attractive in comparison with those of other types of warehouses. However, the additional costs of necessary special measures, such as sprinkling systems and rainwater disposal, need to be taken into account.

7.3 Covered outdoor storage yard

7.3.1 General

A covered outdoor storage yard consists of an outdoor area that is surfaced with impervious material and that has a light-duty roofing construction; it has no enclosing outer walls. Projecting roofing sections, canopies or venetian blinds can be used to protect the storage area against lateral driving rain or lateral solar radiation. A covered outdoor storage yard shall only be operated within the confines of a secured site or plant area.

7.3.2 Products that may be stored

A covered outdoor storage yard is suitable for all products that are insensitive to temperature but that need to be protected against the direct effects of weathering because of their properties or their packaging and marking. Provided that the storage area surface has a basin shape and is surrounded by sufficient storm drains, a covered outdoor storage yard may be used for storing temperature-insensitive, water-polluting products, since it is unnecessary to consider either the quantity of or the disposal of rainwater.

7.3.3 Drainage and discharge

The provisions of 7.2.3 shall apply; in addition, roof run-off shall be drained to storm drains outside the storage area (see also 8.4.4).

7.3.4 Advantages and disadvantages

Because of the good ventilation, a covered outdoor storage yard has the same advantage as an uncovered yard, in that a hazardous, explosive atmosphere can rarely be formed. The climatic disadvantages of a covered outdoor yard are less pronounced, although product damage owing to frost remains a possibility.

7.3.5 Firefighting implications

A covered outdoor storage yard permits the installation of both fire-detection systems and semistationary or automatic fire-extinguishing facilities.

7.3.6 Warehouse technology

The presence of a roof permits the installation of all warehouse technologies; various product ranges and movement structures can therefore be accommodated.

7.3.7 Costs

The capital and operating costs for a covered outdoor storage yard are only slightly higher than for an uncovered outdoor storage yard.

7.4 Surface warehouse

7.4.1 General

A surface warehouse is a building of only one storey, enclosed on all sides, and is the most common type of warehouse. The floor of the warehouse marshalling area (see 7.4.4.2) is either at the level of the traffic area (ground-floor warehouse) or approximately 1 200 mm above it (ramp warehouse).

7.4.2 Products that may be stored

Depending on the construction and building facilities, products of all classes can be catered for.

7.4.3 Firefighting implications

All types of firefighting equipment and apparatus can be accommodated.

7.4.4 Warehouse technology

7.4.4.1 General

All warehouse technologies are applicable. The enclosed construction allows for economical material flow and good accessibility both in normal operation and in an emergency. The useful height of a surface warehouse varies between 4 m for normal block storage and 14 m for rack storage that uses high-lift fork trucks or automatic rack servers on guide rails.

7.4.4.2 Floor levels

The type(s) of vehicle used to transport goods into and from the warehouse and the product movement structure determine the preferred floor level of the warehouse:

a) a ramp warehouse is the most economical alternative when the warehouse caters for a high proportion of rail vehicles, large containers on flat-bed carriers and rear-loading hard-top road vehicles;

b) a ground-floor warehouse is preferable when most of the traffic consists of road vehicles that are unloaded and loaded from the side, or when large containers are the main traffic elements and can then be deposited in the traffic area;

c) a ground-floor warehouse is particularly suitable for large-volume packaged goods with predominantly uniform storage and shipping units, provided that fast, relatively heavy-duty fork-lift trucks can load and unload the vehicles from the side;

d) where a significant amount of traffic movement involves packaged goods with a relatively high proportion of heterogeneous or small-volume loading units, loading and unloading of vehicles from the rear is more easily carried out from ramp level.

NOTE Mixed-floor designs allow for greater flexibility than single-floor designs. For example, ramp spaces can be created in ground-floor warehouses by a reduction in the level of a portion of the traffic area, and ground-level loading areas can be created in ramp warehouses by the use of ramps of different gradients. See also 8.4.3, which covers spillage containment.

7.4.5 Costs

Capital costs for the building itself, for the warehouse and for safety equipment required, depend on the care taken in selecting appropriate warehouse technologies to ensure the economical utilization of warehouse space.

7.5 Multi-storey warehouse

7.5.1 General

A multi-storey warehouse is a building with two or more storeys, and is generally enclosed on all sides.

7.5.2 Products that may be stored

For economical and safety reasons, a multi-storey warehouse shall not be used for storage of higher risk than occupancy class J3 (see 5.7.3). It is therefore not a viable option for the storage of most dangerous goods.

7.5.3 Firefighting implications

7.5.3.1 Means of escape from, and access for firefighters to upper storeys are limited in an emergency.

7.5.3.2 In the upper storeys, escape and firefighting may be aided by the construction of outside balconies and fire escapes. In contrast, smoke and heat build-up can severely restrict access to, and escape from, the lower storeys.

7.5.4 Warehouse technology

7.5.4.1 A multi-storey warehouse is suitable for

a) storage jobs with slow turnover, such as those in stockrooms and spare parts storerooms, and
b) storage jobs related to other operating activities, such as the packaging materials warehouse in filling buildings or the commissioning warehouse in marshalling areas.

7.5.4.2 Columns and walls considerably limit the useful storage volume and the warehouse technologies that can be used.

7.5.5 Costs

As a result of the poor utilization of the enclosed volume and the expense involved in constructing load-bearing storage places, the capital and operating costs of a multi-storey warehouse are the highest of all types of warehouse construction.

7.6 High-rack warehouse

7.6.1 General

The high-rack warehouse is a single-storey building and is enclosed on all sides. It differs from the surface warehouse in that construction heights can be up to 45 m. The main elements of the highrack warehouse are a solid floor or base plate, a rigid rack assembly of steel or concrete, and the roof and wall constructions, to which the rack assembly can be attached.

7.6.2 Products that may be stored

Since each individual storage unit has to be accessible, high-rack warehouses are economical only for large product ranges, coupled with the movement of large quantities and a high rate of stock turnover (more than ten times per year). Materials that do not represent a significant fire hazard may be stored, provided that the warehouse is equipped with overhead sprinklers. Additional safety features are, however, required for storage of most classes of dangerous goods; for example, explosion-prevention installations and forced ventilation are required for the storage of flammable liquids. It is important to note that small fire sections such as those required for a number of different storage classes cannot be economically realized in a high-rack warehouse.

7.6.3 Firefighting implications

When flammable and combustible materials are to be stored, the large warehouse capacity per fire section dictated by the system design requires that automatic extinguishing facilities be so installed as to allow the in-rack sprinkling of all storage places.

7.6.4 Warehouse technology

The storage racks are served by automatic rack servers on guide rails. The storage units have to be moved to and from the warehouse by special transportation facilities. Safety features that are likely to be required are

a) profile checking of the storage units on receipt and during travel,
b) automatic utilization control of the storage place before the load is deposited,
c) automatic path monitors for longitudinal and vertical travel, including automatic cut-off, and
d) automatic monitoring of stock movement to aid the deposition and removal of stock.

7.6.5 Costs

The capital costs per storage unit are relatively high, and are economically justified only when a high rate of turnover of high-value stock is required. When a high-rack warehouse is used in this way, the operating costs per stored unit can be low, resulting in overall costs that are comparable with those of other warehousing systems.

7.7 Special warehouse

7.7.1 General

A variety of special warehouse construction designs are available. As in the case of high-rack warehouses, the construction design is dictated by the required warehousing facilities; in most cases, the warehouse technology is mounted on a base plate which, in turn, supports the roof and wall assemblies.

7.7.2 Products that may be stored

The use of special warehouses is likely to be economical only when small product ranges (maximum ten articles) with a very high rate of stock turnover (at least fifty times per year) have to be stored in large quantities.

7.7.3 Firefighting implications

The type of firefighting equipment needed depends on the individual circumstances.

7.7.4 Warehouse technology

Goods transfer, with appropriate facilities for transport to and from the warehouse, is normally completely automatic. The most common special warehouses include the following:

a) transfer warehouses for pallets, containers and sacks (bin bags);

b) circulating warehouses, that use continuously operating horizontal and vertical conveyors; and

c) stacking warehouses, such as empty-drum warehouses and container terminals.

7.7.5 Costs

The capital costs per storage unit are very high; economic efficiency is likely to be achieved only when goods turnover is very high.

8 Warehouse construction

8.1 General

8.1.1 Building design and construction shall comply with the relevant national building regulations (see foreword), relative to the occupancy class(es) of the building(s) concerned (see 5.7.3). Where the provisions of this clause conflict with those of the relevant national building regulations, the latter shall apply, except that where the provisions of this clause are more stringent than those of the National Building Regulations, the provisions of this clause shall apply.

This clause shall be read in conjunction with

a) the relevant national regulations and statutory provisions dealing with the workplace environment (see foreword).

8.1.2 The design of the structural system of any building shall be carried out in accordance with with the relevant Kenyan standards:

a

8.1.3 The recommendations shall be taken into account with regard to the fire prevention and firefighting aspects of buildings.

8.1.4 An enclosed warehouse shall be substantially closed in, shall be lockable, and shall not have more windows or open spaces in the walls or roof than are necessary to provide an adequate degree of natural lighting (see 8.10) during the day and the necessary ventilation at all times (see 8.8.1).

8.1.5 Load-bearing construction elements, walls, floors, ceilings, doors and gates shall be made of non-combustible materials that are impervious to the dangerous goods to be stored.

NOTE Load-bearing roof components may be made of fire-retardant timber (see 8.5).

8.2 Frame

The frame of a warehouse shall be of concrete or steel. A steel frame used for an enclosed warehouse shall be fire protected to give the required stability.

8.3 Walls

8.3.1 External walls

External walls should preferably be of masonry construction or of metal (steel or similar) cladding. Aluminium cladding shall not be used.

NOTE The construction materials of external walls determine the safety distance to other buildings (see rule

TT2 in SANS 10400:1990).

8.3.2 Separating elements

8.3.2.1 The fire resistance of each wall that acts as a separating element shall be at least

a) 120 min in the case of a wall adjoining a storage area of occupancy class J1, and

b) 60 min in the case of a wall adjoining a storage area of occupancy class J2 or J3 (see 5.7.3).

8.3.2.2 Subject to any more stringent provisions that could be necessitated by technical safety reasons, for example product separation and segregation needs, the areas of the divisions formed within a building by separating elements shall be such as to comply with the relevant provisions

8.3.2.3 Separating walls shall be non-load-bearing and independent of the main structure of the building.

8.3.2.4 Where piping, ducting and electric cables penetrate a separating wall, they shall be either placed in fire-retardant sand cups or so sealed around as to prevent the spread of fire.

8.4 Floors and spillage containment

8.4.1 General

Floors, whether indoors or outdoors, shall be of concrete or of another material impermeable to liquids and impervious to the dangerous goods to be stored. Floors in storage areas shall be of sufficient load-bearing capacity to withstand the weight of stock, racking and any mechanical handling equipment to be used. Floors shall be smooth but not slippery (even when wet), free from cracks to facilitate cleaning, and so designed as to contain leakage and contaminated fire water by means such as a surrounding sill, kerb or bund wall.

8.4.2 Principles of spillage containment

8.4.2.1 Retention facilities have to be provided in stock warehouses (see also annex C), marshalling areas and loading zones to contain and to allow safe treatment of the following, before disposal:

a) flammable, toxic or water-polluting liquids in the event of spillage or of shipping damage;

b) firefighting water contaminated with products, in the aftermath of a fire; and

c) contaminated rainwater, especially in uncovered storage yards, marshalling areas or loading zones.

8.4.2.2 A three-stage catch-basin arrangement is the most efficient means of spillage containment. It normally comprises the following:

a) Primary basins, such as spill collection trays, located directly under the racks on which liquids are stored. The volume of each primary basin is determined by that of the largest storage unit in the rack above it. Because the primary basin is designed to catch undiluted product, its surface has to be resistant to the various products for lengthy periods.

NOTE 1 Sheet metal, metal or other foils, product-resistant paints or special-purpose resins are often used as surfacing materials for primary basins.

NOTE 2 Where drums are stored direct on the floor, a primary basin cannot be used; it might be necessary, however, to coat the floor with a product-resistant surface material.

b) A secondary basin, which is provided to retain larger quantities of product when damage occurs, such as during a fire or major spillage. The secondary basin also has to contain firefighting water and, in the case of uncovered outdoor storage yards, marshalling areas and loading zones, rainwater. Because personnel will always be on the scene quickly to deal with the problem, the surface of the secondary basin is generally not required to be resistant to products for lengthy periods.

NOTE This is not the case for all products; when, for example, chlorinated hydrocarbons are stored, the secondary basin will need to be protected in the same way as the primary basin, to prevent seepage through its surface and the subsequent pollution of ground water.

c) A tertiary basin, which is provided to retain firefighting water and, in outdoor areas, rainwater. The tertiary basin is located outside the storage area. The contents of the secondary basin are pumped or allowed to flow under control into the tertiary basin for treatment and disposal; this facilitates the cleaning up of the storage area and the rapid resumption of normal operations. Generally, the tertiary basin is used rarely and for short periods. Because the concentration(s) of product(s) in the water diverted to a tertiary basin is/are low, tertiary basins are not required to be as watertight as secondary basins. Tertiary basins usually take the form of either reinforced concrete bunded areas, which may be surfaced with a resin or a foil, or ponds lined with a plastics material covered with sand or clay.

NOTE Under certain circumstances, the functions of the various basins can be combined into one catch basin. If this approach is adopted, it is necessary to ensure that the watertightness and product resistance of the surface, and the total retention volume of the single basin, reflect the most stringent requirements of an equivalent three-stage system, and that the single catch basin is located within the fire section in which the products are stored.

8.4.2.3 The size and design of retention facilities will depend on estimates, preferably based on a worst-case scenario, of

a) the quantities and properties of goods likely to escape,
b) the quantity of firefighting water or rainwater that will accumulate,
c) the concentration of products in these waters, and
d) the required retention time before appropriate effluent treatment and disposal can be accomplished.

8.4.3 Spillage containment in indoor storage areas and marshalling areas

8.4.3.1 All warehouse sections in which toxic substances or substances that are known to cause water pollution are stored shall have a floor that consists of a secondary catch basin of capacity at least 10 % of the total available storage volume in the warehouse section. Despite this provision, the kerb, sill or bund wall that forms the perimeter of the floor shall be effectively sealed against spills to a height of at least 250 mm above the warehouse floor level. Annex C gives further guidance in regard to "rules of thumb" that can be used to calculate realistic retention volumes.

NOTE See 12.13.4 for the actions to be taken in the case of leaking or broken containers.

8.4.3.2 Where flammable or corrosive substances are stored, the floor shall slope away from the storage area (primary collection area) to a secondary catch basin or sump of capacity at least 10 % of the total available storage volume of the fire section concerned. The secondary catch basin shall be within the fire section, and shall be such that it can be well ventilated. Care shall be taken in the design of such areas to prevent contamination of the soil or ground water.

8.4.3.3 Where possible, warehouse floors that are to be bunded shall be below ground level, to provide an in-built liquid retention capability. For warehouses constructed above ground level, however, special provision for spillage containment is necessary.

8.4.3.4 Concrete ramps, of apex height equal to that of the bund walls, and of a gradient not exceeding 1 in 10, shall be constructed across all external doorways of storage areas. Where space on the outside of the warehouse is restricted, a ramp may be constructed with its apex inside the warehouse; similarly, where space on the inside of the warehouse is restricted, a ramp may be constructed with its apex outside the warehouse. In either event, containment capability shall be retained by constructing appropriate additional bund walls on either side of the ramp. If the apex of a ramp is outside the warehouse, the roof shall be extended over the ramp to prevent the ingress of rainwater.

8.4.3.5 Warehouse sections that are used entirely for the storage of non-water-polluting solids do not require catch basins, provided that no water-polluting substances can be formed in the event of a fire.

8.4.3.6 Warehouse sections that are used entirely for the storage of non-water-polluting liquids should be provided with primary and secondary catch basins as a precautionary measure.

8.4.3.7 If primary and secondary catch basins are provided, they shall be part of a single fire section. Only the tertiary catch basin may be located outside the fire section.

8.4.3.8 The point(s) at which effluent could overflow from a secondary to a tertiary catch basin shall be well defined and controllable; an appropriate drainage system, such as one that uses a sump pump, shall be provided for emptying the secondary basin into the tertiary basin.

8.4.3.9 A flame propagation inhibitor shall be installed at overflow points when flammable gases or flammable liquids are stored.

8.4.4 Spillage containment in outdoor storage areas

8.4.4.1 Where toxic substances or substances that are known to cause water pollution are to be stored outdoors, spillage containment arrangements identical with those for indoor storage shall be provided.

8.4.4.2 To accommodate rainwater, outdoor bunded areas or ponds shall incorporate a drain controlled by a valve that shall be kept closed at all times except when rainwater is to be released (see 7.2.3).

8.4.4.3 Outdoor secondary and tertiary basins may be connected by means of open gutters or closed pipelines. Where flammable liquids are stored, however, closed pipelines shall be connected by means such as siphons or flame-arrestor gauzes, which prevent "flashback" of burning liquid.

8.4.5 Spillage containment in loading zones

8.4.5.1 Spillage containment arrangements are not required in traffic areas, such as streets, turning areas and parking places.

8.4.5.2 In the areas where loading or unloading is carried out, surface drainage shall be into a central collection pit along separate drainage lines or gutters. Loading and unloading areas shall slope with a gradient of approximately 2 % toward the drains or gutters. The collection pit should be capable of retaining at least one day's rainfall, and shall be connected to the stormwater drain by means of a valve, which shall be kept closed during normal operations. In a loading area, there shall be no drain that leads direct into a sewer or watercourse. Discharge from the collection pit into the stormwater drain may be carried out at the end of each shift or day's work, provided that no shipping damage or product spillage has occurred during working hours. If damage or spillage has occurred, the contents of the pit shall be disposed of under controlled conditions, for example either by pumping it into containers or by waiting until an analysis has shown the proposed discharge to be within permissible limits.

8.4.6 Cleaning

Provision shall be made for washing floors with water or with other cleaning materials, as appropriate to the nature of the goods stored.

8.5 Roofs

8.5.1 Roofs shall be such as to comply with the requirements of part L of SANS 10400:1990, they shall preferably be of pitched design, and shall be so designed as to permit the release of smoke and heat in the event of a fire.

NOTE The early removal of smoke and heat will improve visibility of the source of the fire and retard the lateral spread of the fire.

8.5.2 If roof insulation is used, it shall be of a non-combustible material, such as mineral wool or glass fibre.

8.6 Lightning protection and discharge of electrostatic charges

8.6.1 Adequate protection against lightning, in accordance with the relevant international , shall be provided. Where explosive products are to be stored, the more stringent provisions for the protection of structures designed for the storage of explosives shall apply. Lightning protection systems shall be tested every three years.

NOTE See 19.1 and annex D.

8.6.2 In areas where flammable or explosive substances are stored, appropriate measures shall be taken to prevent the accumulation of electrostatic charges or to discharge these under controlled circumstances. The relevant provisions shall apply (see also 5.1.2).

8.7 Doorways and emergency exits

8.7.1 General

8.7.1.1 Sufficient entrance and exit doorways or openings shall be provided to enable normal warehousing operations to be carried out without compromising security.

8.7.1.2 All emergency exits shall be clearly marked.

8.7.1.3 All exit doors shall be easy to open in the dark or in dense smoke.

8.7.1.4 Emergency exits shall be provided in addition to the main exits (see also 9.6).

8.7.2 Fire-doors

8.7.2.1 All openings in separating walls shall be fitted with self-closing fire-door assemblies of at least the same fire resistance as the wall itself, and that comply with the requirements of

8.7.2.2 Doors provided for fork-lift truck access through separating walls shall be fitted with a fusible link or a link activated by an automatic fire detection system to ensure automatic closure of the door in the event of a fire. The space required for closure shall be kept free from obstruction. See figure 1 for an example of a typical arrangement.

Legend : A: Fusible links. One link positioned over door frame so that heat/flame encroaching from storage area on far side of wall will activate it.

B: Counterweight. Cable passes through running eye on top of counterweight; it is not fixed to counterweight.

C: Inclined track.

D: Emergency exit of fire resistance equal to that of fire-door.

Figure 1 — Self-closing fire-door

8.8 Ventilation, air conditioning and heating

8.8.1 Ventilation

8.8.1.1 General

Every covered storage area shall be provided with either adequate natural ventilation or forced draught ventilation that ensures at least five changes of air per hour. In general, poor ventilation occurs if vents are positioned near the floor, and good general ventilation occurs where vents are positioned both near the floor and near or in the roof. It shall be possible to shut off a forced draught ventilation system by means of a main switch in the event of a fire or the escape of poisonous or corrosive gases. Where highly flammable gases or flammable liquids are stored, effective extraction shall be provided, at or near floor level, and the ventilation shall be so efficient as to prevent the formation of an explosive atmosphere. A ventilation rate of up to 12 air changes per hour could be required in certain cases. Appropriate monitoring using an explosimeter is recommended. Where forced draught ventilation is applied, it shall operate continuously during periods of normal operation, and might even need to operate during periods when the warehouse is unmanned.

NOTE Forced draught ventilation systems might be required to be flame roof.

8.8.1.2 Smoke and heat ventilation

The following arrangements are appropriate for smoke and heat ventilation:

a) natural lighting openings covered with domes or strips of a plastics material;
b) automatically or manually opening exhaust shutters; and
c) permanent ventilation openings in or near the roof.

The positions of all panels that can be opened in external walls shall be marked on the outside of the building, to permit easy identification by fire authorities.

Where the floor area of any room exceeds 500 m_2, certain minimum size requirements could apply to ventilation openings in order to comply with the relevant national building regulations (see foreword); alternatively, a mechanical smoke ventilation system could be required.

8.8.2 Air conditioning and humidity control

8.8.2.1 Air conditioning shall preferably be of the ducted air type, with the air-conditioning plant situated well away from the storage area. Individual electric air conditioners shall not be used in areas where flammable materials are stored. Where it is necessary to humidify the storage area, this shall be done by direct spraying of steam or water vapour. Dehumidification could be required where a large quantity of substances that react violently with water are stored. Where room humidity is critical, appropriate monitoring shall be carried out.

8.8.2.2 Any air-conditioning system or artificial ventilation system in any building shall be so designed as to prevent the distribution of products of combustion in the event of a fire.

8.8.3 Heating

Where room heating is required to ensure product integrity, it shall be so designed as to ensure that the temperature in the warehouse does not fall below 5 °C. Heating systems shall preferably be based on hot water or steam, with the heat source and pipes, radiators or similar equipment that are likely to become hot, so positioned as to prevent direct heating of the stored product. Direct electrical room heating equipment, or portable gas-fired or oil-fired room heaters shall not be used in areas where flammable materials are stored. Where a maximum allowable temperature applies, appropriate monitoring systems shall be used. Facilities for heating a circulating medium shall be located outside the storage area or in a separate room. Where building insulation is used, it shall be of a non-combustible material such as mineral wool or glass fibre.

8.9 Water supplies and drainage

8.9.1 Water supplies

8.9.1.1 Potable water

Wherever practicable, potable water supplies shall be separate from firefighting water supplies

8.9.1.2 Firefighting water

Firefighting water supplies shall be such as to permit the warehouse to comply with the provisions of 10.2.1.1.

8.9.2 Drainage

NOTE For further information on the drainage of uncovered and covered outdoor storage yards, see 7.2.3 and 7.3.3 respectively.

8.9.2.1 Open drains shall not be used in buildings in which toxic chemicals are stored.

8.9.2.2 Drainage of spilled product, water used for washing down the inside of the premises, firefighting water and the contents of bunded areas shall be by means of a collection pit or catch basin (see 8.4), from which the contents shall not be discharged unless analysis and appropriate treatment have shown the effluent to be within statutory limits. Direct drainage into storm water drains or water courses is prohibited.

8.9.2.3 Gutters, downpipes and storm water drains shall be provided for the removal of rainwater from the roof and outside areas. Downpipes should preferably be external but, if internal, they shall be non-combustible. Downpipes shall be protected against damage that could be caused by vehicles and pallets.

8.10 Lighting

8.10.1 Where warehousing operations are only carried out during daytime and natural lighting provides a sufficient level of illumination to ensure compliance with the regulations, artificial lighting need not be installed.

8.10.2 Artificial lighting shall be in accordance with SANS 10114-1, and shall be such that undue warming of products is avoided. Lights shall be located above entrances and aisles, and not above product stacks.

8.10.3 Wiring for electric lighting shall be in accordance with SANS 10142-1 and the necessary certificate(s) of compliance shall be obtained.

8.10.4 Where electric lighting is installed in a warehouse that is to be used for flammable or explosive products, it shall be protected in accordance with the relevant provisions of SANS 10108 for the class and division of hazardous location that the warehouse represents.

8.10.5 No switches may be installed inside a stock warehouse that is to be used for flammable or explosive products. Main switches shall be positioned outside the warehouse and shall be protected against the weather.

8.10.6 Subject to the provisions of 8.10.1, emergency lights shall be placed at strategic positions along escape routes. Each light shall have an independent power supply, such as a battery, which shall be kept fully charged during normal operations. Emergency lighting shall be so arranged that failure of the main supply will automatically switch on the emergency lighting.

8.11 Electrical equipment and installations, other than for lighting

8.11.1 All electrical installations shall be in accordance with IEC and the necessary certificate(s) of compliance shall be obtained. Only the electrical facilities that are absolutely vital for the operation of a warehouse may be located in the warehouse. (See also 8.10.5.) All electrical apparatus used shall be protected in accordance with the provisions of SANS 10108. All relevant provisions of SANS 10086-3 and SANS 10119 shall be complied with. When relevant, additional safety requirements of local authorities shall be complied with.

NOTE Insurers might also insist on additional safety requirements.

8.11.2 A separate electrical switch room shall be constructed. It shall be located against an outer wall of the warehouse building, and shall be separated from the storage area by walls that provide a fire resistance of 120 min. The door(s) that permit entry to the electrical switch room shall not open direct into the stock warehouse. A drainage system shall prevent the entry of water into the switch room. The main power line into the electrical switch room shall not pass through the storage area; it shall be laid either along the outside of the building or in earth and encased in concrete. Switching to back-up or emergency power supplies, including battery back-up supplies for alarm systems, or to independent default lines or power generators, shall be done either in the switch room or in a safe area well away from storage areas.

8.11.3 Wherever practicable, electrical equipment other than for permanent lighting, such as power points, power tools or hand lights, shall not be installed in a warehouse that is used for flammable or explosive products. Where such electrical equipment is used, it shall be protected in accordance with the provisions of SANS 10108 for the appropriate class and division of hazardous location that the warehouse represents.

8.11.4 Operating procedures shall provide for the isolation of non-essential electrical equipment during periods when the warehouse is unmanned.

8.11.5 Battery charging facilities for electrically operated fork-lift trucks should preferably be in an open-sided, covered area within the marshalling area. If this is not possible, the room or area in which they are kept shall be well ventilated at all times, without direct access from the stock warehouse. Vents in such a room or area shall be as high as possible in the walls, to prevent the accumulation of hydrogen gas. Electrical equipment in this room or area shall be protected in accordance with the provisions of SANS 10108 for the appropriate class and division of hazardous location that the room or area represents.

8.12 Racks, shelving and warehouse storage technology

Dangerous goods shall not be stored direct on the floor. Adequate racks and shelves shall be provided for small packages but, in general, provision shall be made to store goods on pallets or in standardized storage containers that, especially in the case of larger warehouses, can be more easily handled by fork-lift trucks. Racks and shelves shall be non-combustible. The warehouse storage technology to be installed will depend on the quantities, types and storage classes of products to be stored, the scale of the warehousing operation, the turnover rate and logistical and economic factors which are discussed in detail in 11.2.

8.13 Means of impeding the progress of a fire

Equipment such as fire shutters and draught curtains shall be installed as necessary and as recommended by the local fire authority. Where the design of the building necessitates it, a fireman's lift shall be installed.

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8.14 External signs

8.14.1 At each entrance to a stock warehouse, the warning “Storage of dangerous goods – Unauthorized entry prohibited” shall be displayed in red letters against a white background. The warning notice shall be in one of the official languages and in at least one other language indigenous to the region. The height of the letters shall be at least 75 mm.

8.14.2 Where only one hazard class of dangerous goods (see 4.2) is stored in a warehouse, the relevant class diamond (see table 2) shall be displayed at each entrance. Where more than one hazard class of dangerous goods are stored, a “mixed load” diamond shall be displayed (see figure 2). The dimensions of the hazard class diamond shall be at least 250 mm x 250 mm.

NOTE See 9.7 for hazard warnings to be displayed inside a warehouse.

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8.14.3 Symbolic safety signs shall be used as necessary outside the warehouse to denote safety-related features of the premises, including the following:

a) "no smoking", "no naked flames" and "no fires" restrictions and other specific hazard warnings;
b) the positions and types of fire-related equipment (such as extinguishers, hose reels, hydrants, mains water supplies and alarm switches); and
c) areas in which protective clothing or apparatus is required.

8.14.4 All panels that can be opened in the building walls shall be appropriately identified to permit easy identification by fire authorities.

8.14.5 All external signs used shall be relevant and appropriate, and shall be so positioned that they are

a) clearly visible at all times,
b) not subject to misinterpretation, and
c) not subject to damage during normal warehousing operations.

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